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An introduction of Professor Owe Axelsson and Professor Miloš Zlámal

Dear Owe, Dear Miloš,
Ladies and Gentlemen, Dear Colleagues:

It was with great pleasure that I accepted the honorable duty of introducing today's jubilants to whom the Modelling'94 meeting is devoted – Professors Owe Axelsson and Miloš Zlámal.

As I said, I was very pleased with the honour. However, my enthusiasm cooled when I was told that the time available is just ten minutes! I will try to convince you that I found a generalized solution to this problem; you may find it a weak solution, possibly very weak solution. On the other hand, I should say that the solution is more than a week solution, but as mentioned already, it must be a ten minutes solution.

I also hope that everybody in the audience understands that my introduction can have only a rather general character. Therefore, I shall give few details and certainly not an exhaustive survey.

My idea is to utilize the principle of analogy. It will concern one of my most beloved composers Antonín Dvořák and the analogy is between the success of some of his compositions with appropriate celebrated works of the jubilants. As a typical basis for such an apporoach, let me mention Dvořák's New World Symphony. One can easily accept the claim that Dvořák would have become famous by composing just his New World Symphony and nothing else. My first task is thus to determine which result of each of the jubilants would have made each equally famous and uniquely identifiable within the all time society of mathematicians.

On the other hand, it is hard to imagine that a composer who was able to come out with a symphony like Dvořák's New World Symphony would not enrich our culture with some other works whose standard value would not be superior to some world production criterion. And again, you may feel a very close relationship between a first class composer and first class scientist.

It is well known that Dvořák was very proud for his operas and evaluated them very highly. He was disappointed that none of his operas were similarly evaluated and accepted by the world musical community. However, today, Dvořák's operas are becoming popular and are very welcome at world opera houses, like the Metropolitan opera in New York, where Rusalka was performed recently with magnificent success. What is the analogy? There may exist some results obtained by, say, a mathematician that may have been underestimated by the mathematical community whilst their true value might have been very high as well as the author's effort and personal evaluation. In such a case we are not able to identify these results now, but this will be done in the future.

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Before I go on to describe each of the jubilants in detail, let me answer the following question. What do have these gentlemen in common?

In addition to them both being excellent scientists they are very modest. On the other hand, they are each able to enjoy life and they do so, each in his own style, naturally.

They are both friendly and there exist many persons who wish to become friends of them.

Another common characteristic concerns their manner of presenting their thoughts to readers. Their style of writing is not only extremely rigorous but simultaneously relatively very easily readable. After having read any paper by each of them I always have feeling that the problem is rather easy and ask why did I not solve it myself. Did you have similar feelings? Didn't you?

They both are able to create a working atmosphere. This is reflected among other things in the fact that they have a series of coworkers in various countries. Actually, many of their papers have been written jointly in cooperation with their colleagues. Needless to say that they both are invited to many meetings, summer schools, symposia, conferences, visiting professorships, etc. I can only hardly find any academic place in the world which they had not visited yet.

Our both jubilants can serve as an example of persons who are devoted to science. Their academic life is full of important and responsible duties on both national and international levels.

1. Axelsson's major achievements

What is an analogue of Dvořák's New World Symphony in Owe's scientific life?

The answer is immediate. Owe is the father of the concept of preconditioning. He also perfected the preconditioning techniques via various further tools like block incomplete factorization, the multi-level approach and diagonal balancing, so that it became a powerful and almost universal means of solving algebraic problems induced by discretization of boundary value problems.

Among those concepts and methods that may be considered as analogues of Dvořák's symphonic compositions the following ones can be counted:

- diagonal balancing,
- multi-grid methods, optimal two-dimensional methods,
- black box methods of solving linear algebraic systems of equations,
- incomplete factorization, block incomplete factorization,
- parallel algorithms,
- multi-level Newton like methods,
- approximate methods for Initial Value Boundary Value Problems,
- two monographs: *Finite Element Solution of Boundary Value Problems. Theory and Computation* (jointly with V.A. Barker) and *Iterative Solution Methods.*

Among Axelsson's organizational achievements I should mention his work as Chief-Editor of the international journal Numerical Linear Algebra With Applications published by Wiley Publishers. It is in no way an accident that a meeting of the editors and members of the editorial board of this journal will be held on the occasion of Modelling'94 in Prague.

2. Zlámal's major achievements

What is the most important result of Miloš Zlámal – his analog to Dvořák's New World Symphony?

The answer is obvious. It is the paper which started the era of Finite Elements as a mathematical discipline. On this occasion, let us recall Phillippe Ciarlet's description of the situation in the Introduction of his monograph devoted to the finite element method. Zlámal's paper was the first one to present genuinely the two-dimensional finite element technique. Actually, the strategies of investigation in the finite element theory have not been changed substantially since Zlámal's introducing his techniques even though whilst the tools have been broadened and perfected enormously. We can say that even today the FEM is governed by Zlámal's method. Thus, Miloš has already become unforgetable.

What are the other important works of Zlámal that can be considered as analogues to Dvořák's symphonic compositions?

Let me only briefly mention some of them. Here, they are:

- FEM – finite element method,
- two-dimensional elements, Zlámal's element,
- ideal curved element,
- curvilinear elements,
- FEM for nonstationary problems,
- superconvergence,
- $\mathscr{C}^1$-mappings,
- semiconductor modelling and appropriate numerical methods,
- the box method in BVP.

There are some analogues to Dvořák's early compositions in Zlámal's mathematical legacy. These are the early Zlámal papers on ODEs and later on PDEs. We should add to this collection also his major achievements prior his Finite Element period; to this class there belong the papers on Finite Difference Methods, some of them jointly with Jim Bramble and Bert Hubbard.

There is another parallel of Zlámal and Dvořák. As it is well known, Dvořák received the honorary degree of Doctor at Cambridge University. Similarly, Zlámal received a honorary Doctor title at the Technische Universität Dresden. The obvious difference is that Dvořák's award was for Music while in Miloš' case it was Mathematics. Besides this very prestigious title Prof. Zlámal has received many further prizes and awards most of them I must omit to mention. He became an Honorary Member of the Union of Czechoslovak Mathematicians and Physicists. Today's award of the Faculty of Mathematics and Physics of the Charles University will enlarge his collection of similar awards, all of which witness the success and merits of the awardee.

3. Concluding remarks

As you may have observed, I mentioned just those results of the jubilants that have made them famous. Let me conclude my performance by expressing a general opinion that those results I have not quoted will share the same fate as that of Dvořák's operas having been in the past in the shadow of his symphonic compositions and are nowadays becoming as popular as the symphonic

works. The already recognized results of Axelsson and Zlámal belong to the treasure of the world Mathematics and more precisely, to the world scientific treasure.

Independently of any analogies we all evaluate the scientific contribution of our jubilating individuals highly. Let me wish them, also in your name, many further deep and interesting results and the opportunity to continue to produce them, let us wish them continuing good health, happiness and satisfaction in the future.

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I. Marek
Charles University, Prague, Czech Republic